

What is claimed is:

1. An apparatus for controlling multi-mode radio access comprising:

a physical layer;

a radio system layer connecting with the physical layer for performing
5 medium access control; and

a radio adaptation layer, which connects with the radio system layer, at
least comprising:

a configuration controller used to establish or control at least a radio
link according to a signal packet so as to perform seamless handoff within
10 different radio systems and set corresponding traffic control parameters; and

a traffic controller used to transmit a data packet according to the traffic
control parameters and requirements of quality of service (QoS) of the data
packet.

2. The apparatus as claimed in claim 1 further comprising:

15 a network layer for passing the data packet and signal packet to the
radio adaptation layer, the network layer using an Internet protocol (IP) so as
to make the apparatus able to roam within the different radio systems and
support QoS mechanisms.

3. The apparatus as claimed in claim 2, wherein the IP is a mobile IP.

- 20 4. The apparatus as claimed in claim 2, wherein the QoS mechanisms comprise a
IntServ or a DiffServ mechanism.

5. The apparatus as claimed in claim 1, wherein the physical layer comprises a
first reconfigurable transceiver and a second reconfigurable transceiver for
establishing radio links within the different radio systems.

- 25 6. The apparatus as claimed in claim 1, wherein the physical layer only has a

first reconfigurable transceiver or a non-configurable transceiver.

7. The apparatus as claimed in claim 1, wherein the radio system layer comprises at least a media access controller corresponding to a radio module.

8. The apparatus as claimed in claim 7, wherein the media access controller is a wireless local area network (WLAN) media access controller, a 3G protocol stack, a 802.16 media access controller or a bluetooth media access controller.

9. The apparatus as claimed in claim 1, wherein the radio adaptation layer further comprises a network control interface to recognize a format of a packet sent from the network layer.

10. The apparatus as claimed in claim 1, wherein the configuration controller comprises:

a call admission control for managing present wireless network resources of the apparatus; and

a radio system selector connecting with the call admission control for determining if it is necessary to perform the seamless handoff according to a status of a radio link.

11. The apparatus as claimed in claim 10, wherein the configuration controller comprises:

a service manager connecting with the call admission control for setting the traffic control parameters, and establishing or correcting the status of the radio link;

a radio monitor connecting with the call admission control and the radio system selector for monitoring the status of the radio link; and

a radio module controller connecting with the radio system selector for loading a radio module program to a radio module.

12. The apparatus as claimed in claim 11, wherein the configuration controller comprises:

a configuration control interface connecting with the service manager, the radio monitor and the radio module controller for providing an unified control interface between the configuration controller and the radio module.

13. The apparatus as claimed in claim 1, wherein the traffic controller comprises:

a classifier for classify the data packet and deliver the classified data packet to a corresponding queue;

a conditioner connecting with the classifier for controlling the classified data packet in the queue;

a scheduler connecting with the conditioner for scheduling the queue according to the traffic control parameters; and

a traffic control interface connecting with the scheduler for providing an unified control interface between the traffic controller and the radio moduler.

14. The apparatus as claimed in claim 13, wherein the conditioner comprises:

a meter for measuring and counting according to data attributes of the the data packet;

a dropper for dropping the data packet according the requirements of QoS; and

a shaper for retarding a transmission of the data packet according the requirements of QoS.

15. The apparatus as claimed in claim 1, wherein the radio adaptation layer further comprises:

a radio module connecting with the configuration controller and the traffic controller for converting the data packet to a specific radio system

format before sending the data packet to the radio link, providing the radio link with QoS in an one-to-one or one-to-multiple manner and performing a monitoring of management and power saving to make the configuration controller able to modify the radio module.

5 16. The apparatus as claimed in claim 15, wherein the radio module comprises at least a radio module corresponding to the radio systems.

17. The apparatus as claimed in claim 16, wherein the radio module is a WLAN module, a 3G module, a 802.16 module or a bluetooth module.

10 18. A packet-transmitting method for controlling multi-mode radio access comprising:

 recognizing a format of a received packet;

 determining if the received packet is a signaling packet;

 passing the received packet to a configuration controller if the received packet is the signaling packet, establishing a corresponding radio link according to parameters of the signaling packet and present network resources, and setting corresponding parameters of a traffic controller to fit predetermined requirements of QoS; and

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 passing the received packet to the traffic controller if the received packet isn't the signaling packet but a data packet, controlling a quality of a connection according to predetermined parameters of traffic control and then sending out the data packet orderly.

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19. The method as claimed in claim 18, wherein the step of passing the received packet to the configuration controller further comprises:

 abstracting a traffic parameter from the signal packet;

25 translating QoS attributes and checking available resource of radio link;

loading a usable radio module program to establish the corresponding radio link if a connection is admitted;

setting the corresponding parameters of the traffic controller after the radio link is established completely; and

5 converting the signaling packet to a specific radio system format and then sending the signaling packet out.

20. The method as claimed in claim 19, wherein the step of passing the received packet to the configuration controller further comprises:

10 rejecting connection establishment and sending out a message of rejection if the connection is not admitted or the radio link isn't able to establish completely.

21. The method as claimed in claim 18, wherein the step of passing the received packet to the traffic controller further comprises:

15 classifying the data packet and delivering the classified data packet to a corresponding queue;

 measuring, dropping or retarding the data packet;

 scheduling a plurality of queues; and

 converting the data packet to a specific radio system format for transmitting in a corresponding radio system; and

20 sending the data packet out.

22. A seamless handoff method for controlling multi-mode radio access comprising:

 determining if handoff is necessary according to a status of a present radio link;

25 switching to a new radio link;

releasing an old radio link;

translating QoS attributes for mapping parameters; and

setting parameters of a traffic controller to fit the new radio link.

23. The method as claimed in claim 22, wherein the step of determining further
5 comprises:

reporting the status of the present radio link;

determining if a quality of the present radio link degrades;

obtaining an information of a radios system and determining if the
handoff is necessary; and

10 modifying a setting of a radio module to improve the quality of the
present radio link if the handoff isn't necessary.

24. The method as claimed in claim 22 comprising following steps before the step
of switching:

loading a radio module program and setting its parameters;

15 establishing the new radio link by employing the radio module program;
and

determining if the new radio link is suitable.

25. The method as claimed in claim 22 comprising a step as below after the step
of setting:

20 informing an upper layer of a variation of the new radio link.

26. A radio link releasing method for controlling multi-mode radio access
comprising:

issuing a message for releasing a radio link as an application program of
an upper layer terminates a connection actively;

25 passing the message for releasing the radio link to an end of a network;

releasing the radio link by a radio module if a number of other connections existing in the radio link is zero and informing a call admission control that the radio link is released; and

5 informing the call admission control that the connection is terminated if the number of other connections existing in the radio link is not zero.

27. The method as claimed in claim 26 comprising a step as following when the application program of the upper terminates the connection passively:

informing the call admission control that the radio link is released if the radio module issues that the radio is released.

10 28. The method as claimed in claim 27 comprising following steps if the radio module doesn't issue that the radio is released:

discovering that the radio is released by the radio module after a period of time;

15 releasing the radio link by the radio module if a number of other connections existing in the radio link is zero and informing the call admission control that the radio link is released; and

informing the call admission control that the connection is terminated if the number of other connections existing in the radio link is not zero.

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